CLAIMS

1. A method of removing CO_2 from a gaseous stream comprising:

contacting a gaseous stream with a solution, the solution being formed by combining at least:

a primary or secondary polyamine having an amine concentration of at least 3.0 equivalents/Kg water,

an alkali salt having a concentration of at least 1.0 equivalents/Kg water, and

water;

whereby contacting removes CO_2 from the gaseous stream; and

regenerating the solution.

2. The method of claim 1, wherein the polyamine is piperazine, a piperazine derivative, ethylenediamine, dimethyl ethylenediamine, pyrazolidine, imidazolidine, 2-(2-pyrrolidyl)pyrrolidine, or 2-(2-imidazolidyl)imidazolidine.

3. The method of claim 1, wherein the alkali salt is potassium carbonate, sodium carbonate, lithium carbonate, a bicarbonate salt, a bisulfide salt or a hydroxide salt.

4. The method of claim 1, wherein the gaseous stream is contacted with the solution at a temperature of approximately 25°C - 120°C.

5. The method of claim 1, wherein the rate constant for the reaction of CO_2 with the piperazine derivative (K_{PZ}) is at least 25 m^3/mol-s at 25°C.

6. The method of claim 1, wherein the solution further comprises an additive.

7. The method of claim 1, wherein the polyamine concentration and the alkali salt concentration are at least 2.3 m.

8. The method of claim 1, wherein the ratio of equivalents of alkali salt to equivalents of polyamine is 0.3 – 3.0.

9. The method of claim 1, further comprising applying a water wash system, wherein the water wash system collects the polyamine from treated gaseous stream.

10. The method of claim 1, wherein the rate for the solvent-mediated removal of CO_2 from the gaseous stream is at least 1.5 times the rate for CO_2 removal in a method using an aqueous solution of 5.0-M monoethanolamine.

11. A composition, comprising:

a piperazine derivative having a concentration of at least 3.0 equivalents/Kg water,

a potassium salt having a concentration of at least 1.0 equivalents/Kg water, and

water,

wherein the ratio of equivalents of alkali salt to equivalents of the piperazine derivative is 0.3 – 3.0.

12. The composition of claim 11, wherein the piperazine derivative is piperazine.

13. The composition of claim 11, wherein the potassium salt is potassium carbonate, potassium bicarbonate, potassium bisulfide, or potassium hydroxide.

14. The composition of claim 11, wherein the ratio of equivalents of alkali salt to equivalents of piperazine derivative is 0.5 – 2.0.

15. The composition of claim 11, wherein the concentration of the piperazine derivative is at least 5.1 equivalents/Kg H_2O and the concentration of the alkali salt is approximately 5.1 equivalents/Kg H_2O.

16. The composition of claim 11, further comprising an antifoaming agent, an antioxidant, a corrosion inhibitor, a flocculation aid, or a mixture thereof.

17. A method of removing CO_2 from a gaseous stream comprising:

contacting a gaseous stream with a solution, the solution being formed by combining at least:

a primary or secondary polyamine having an amine concentration of at least 5.1 equivalents/Kg water,

an alkali salt having a concentration of at least 5.1 equivalents/Kg water, and

water;

whereby contacting removes CO_2 from the gaseous stream; and

regenerating the solution.

18. The method of claim 17, wherein the concentration of the polyamine and the concentration of the alkali salt are at least 5.5 equivalents/Kg water.

19. The method of claim 17, wherein the concentration of the polyamine and the concentration of the alkali salt are approximately equal.

20. The method of claim 17, wherein the polyamine is piperazine, a piperazine derivative, ethylenediamine, dimethyl ethylenediamine, pyrazolidine, imidazolidine, 2-(2-pyrrolidyl)pyrrolidine, or 2-(2-imidazolidyl)imidazolidine.

21. The method of claim 17, wherein the alkali salt is potassium carbonate, sodium carbonate, lithium carbonate, a bicarbonate salt, a bisulfide salt or a hydroxide salt.

22. The method of claim 17, wherein the gaseous stream is contacted with the solution at a temperature of approximately 25°C - 120°C.

23. The method of claim 17, wherein the rate constant for the reaction of CO_2 with the piperazine derivative (K_{PZ}) is at least 25 m^3/mol-s at 25°C.

24. The method of claim 17, wherein the solution further comprises an additive.

25. The method of claim 17, wherein the rate for the solvent-mediated removal of CO_2 from the gaseous stream is at least 1.5 times the rate for CO_2 removal in a method using an aqueous solution of 5.0-M monoethanolamine.

26. A method of removing CO_2 from a gaseous stream comprising:

contacting a gaseous stream with a solution, the solution being formed by combining at least:

a primary or secondary polyamine having an amine concentration of at least 3.0 equivalents/Kg water,

an alkali salt having a concentration of at least 1.0 equivalents/Kg water, and

water;

wherein the solution contains less than 1% of a monohydric or polyhydric alcohol;

whereby contacting removes CO_2 from the gaseous stream; and

regenerating the solution.

27. The method of claim 26, wherein no alcohol is added to the solution.

28. The method of claim 26, wherein the polyamine is piperazine, a piperazine derivative, ethylenediamine, dimethyl ethylenediamine, pyrazolidine, imidazolidine, 2-(2-pyrrolidyl)pyrrolidine, or 2-(2-imidazolidyl)imidazolidine.

29. The method of claim 26, wherein the alkali salt is potassium carbonate, sodium carbonate, lithium carbonate, bicarbonate salt, a bisulfide salt, or a hydroxide salt.

30. The method of claim 26, wherein the gaseous stream is contacted with the solution at a temperature of approximately 25°C - 120°C.

31. The method of claim 26, wherein the rate constant for the reaction of CO_2 with the piperazine derivative (K_{PZ}) is at least 25 m^3/mol-s at 25°C.

32. The method of claim 26, wherein the solution further comprises an additive.

33. The method of claim 26, wherein the polyamine concentration and the alkali salt concentration are at least 2.3 m.

34. The method of claim 26, wherein the ratio of equivalents of alkali salt to equivalents of polyamine is 0.3 – 3.0.

35. The method of claim 26, wherein the rate for the solvent-mediated removal of CO_2 from the gaseous stream is at least 1.5 times the rate for CO_2 removal in a method using an aqueous solution of 5.0-M monoethanolamine.

36. A method of removing CO_2 from a gaseous stream comprising:

contacting a gaseous stream with a solution, the solution being formed by combining at least:

a piperazine derivative having an amine concentration of 3.0 – 10.0 equivalents/Kg water,

an alkali salt having a concentration of 3.0 – 10.0 equivalents/Kg water, and

water;

wherein the concentration of the piperazine derivative and the concentration of the alkali salt are approximately equal;

whereby contacting removes CO_2 from the gaseous stream; and

regenerating the solution.

37. The method of claim 36, wherein the piperazine derivative is piperazine, aminoethylpiperazine, hydroxyethylpiperazine, 2-(3-pyrrolidyl)piperazine, 3-(3-piperidyl)piperidine, 3-(2-piperazinyl)piperidine, 3-(3-pyrrolidyl)piperidine, or 2-(2-piperazinyl)piperazine.

38. The method of claim 36, wherein the alkali salt is potassium carbonate, sodium carbonate, lithium carbonate, a bicarbonate salt, a bisulfide salt, or a hydroxide salt.

39. The method of claim 36, wherein the gaseous stream is contacted with the solution at a temperature of approximately 25°C - 120°C.

40. The method of claim 36, wherein the rate constant for the reaction of CO_2 with the piperazine derivative (K_{PZ}) is at least 25 m^3/mol-s at 25°C.

41. The method of claim 36, wherein the solution further comprises an additive.

42. The method of claim 36, wherein the rate for the solvent-mediated removal of CO_2 from the gaseous stream is at least 1.5 times the rate for CO_2 removal in a method using an aqueous solution of 5.0-M monoethanolamine.